

AUTISM AND HEARING LOSS: RECOMMENDATIONS FOR IMPROVED
DIAGNOSTIC EVALUATIONS AND INTERVENTIONS

Capstone Project

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ABSTRACT

The goal of this paper is to review the existing literature about hearing loss and autism and make recommendations based upon these findings to improve diagnostic techniques, intervention programs, and hearing aid outcomes. Autism continues to be on the rise worldwide as well in the United States. Audiologists are typically the first professionals who have contact with a child who is suspected of autism. This paper examines the audiologist's role in making appropriate referrals if they suspect a child has a developmental difficulties. In addition, the paper will examine the audiologist's role in the management of children with hearing loss and autism. Also, the paper will discuss the audiologist's role on a diagnostic/therapeutic team for a child suspected of a developmental disorder. The characteristics of autism and how they impact the audiological evaluation will be discussed. Specific recommendations will address modifications that can help improve the behavioral audiological process. Intervention and hearing aid plans that address the unique needs of children with hearing loss and autism will be examined. Finally, the paper will present recommendations for future study in the area of autism and hearing loss.

DEDICATION

To my family for all of their love and support through the years.

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LIST OF ABBREVIATIONS

ABR	Auditory Brainstem Response
BOA	Behavioral Observation Audiology
BTE	Behind-the-ear hearing aid
CHIP	Colorado Home Intervention Program
CPA	Conditioned Play Audiometry
dB HL	decibels Hearing Level
IEP	Individualized Education Program
IFSP	Individualized Family Service Plan
IPL	Interpeak latencies
Hz	Hertz
MLE	Mediated Learning Experience
OAE	Otoacoustic emission
PTA	Pure tone average
RECD	Real-Ear to Coupler Difference
SAT	Speech Awareness Threshold
SKI-HI	Hearing Intervention Program (Utah State University)
SRT	Speech Recognition Threshold
TDH	Telephonics Distortion Headphones
VRA	Visual Reinforcement Audiology

CHAPTER 1

INTRODUCTION

In today's health care climate there is an increasing call for evidence based practice to guide clinical decisions. Evidence based research should be utilized to make clinical judgments and decisions rather than anecdotal evidence. This is not say that the clinician's own experiences and expertise should be ignored. Instead, the clinician should come to a clinical decision by integrating systematic research as well as examining their and their colleagues own anecdotal evidence. Health care access and cost continue to be a major issue both in the United States and abroad. There is an increasing push to make the health care more efficient and cost effective by critically evaluating treatment options. In the end, the biggest concern is how to provide the best possible care for the patient that will result in the most positive outcome. Sometimes this may result in the need for more aggressive screening/prevention procedures that will result in greater cost at the onset of treatment. The counterbalance is that the initial treatment/intervention/screening will result in fewer resources spent over the course of time. One example of this is newborn hearing screening programs. If hearing loss can be identified before 6 months of age and intervention started in a prompt fashion, considerable fewer special education and related services resources will be needed (Yoshinaga-Itano and Apuzzo, 1998).

Team Approach to Patient Care

Children who present with complex needs are often better served with a team managing their treatment rather than a single professional. Another aspect of the changing health delivery model is the need for interprofessional teamwork (Wilson and Gleason, 2001). Often times children receive services from multiple professions. Planning and communication between professionals providing services is crucial to the child's development (Pratt and Rickerts, 2004). Children with multiple disabilities present with complex needs. Thus, collaboration of care between professionals, the child, and the family is crucial to the success of the treatment and intervention (Patel et al., 2008). To take the collaboration of care to the next step a team approach may be most appropriate for the child and family.

Multidisciplinary and Transdisciplinary Models

There are many different models to approach team based healthcare. For the purposes of this paper, a transdisciplinary and multidisciplinary approach will be discussed. According to Choi and Pak (2006), in a multidisciplinary approach each professional completes their own discipline specific assessment and intervention for the patient. Each team member may gain knowledge and skills from other disciplines, but each team member functions within the boundaries of their profession (Choi and Pak, 2006). Typically, a multidisciplinary approach is more hierarchical in nature and the team leader tends to be a physician. Although the team members may develop a plan of care, each discipline works independent of the other discipline and at times may present contrasting views on treatment and therapy services (Choi and Pak, 2006). This approach

represents an outdated form of health care delivery. Information may be exchanged about diagnosis and treatment progress, but for the most part the professionals fail to collaborate or integrate their care.

The new model calls for cross disciplinary interactions to be more than just a telephone call or electronic mail exchange (Choi and Pak, 2006). Instead, a transdisciplinary approach calls for a team of professionals involved in the case to be formed. Soskolne (2000) defined the transdisciplinary model as a health care approach of differing professionals who integrate services that transcends traditional discipline specific boundaries. Members of a transdisciplinary think and work beyond their individual disciplines to formulate a novel approach for a particular patient (Soskolne, 2000). Two crucial parts of this model are role release and role expansion. Role release is the acceptance that another professional from a differing discipline has the skills and knowledge to do a better job providing treatment for a particular patient problem (Choi and Pak, 2006). For example, if a child was fit with amplification and is having difficulty putting the hearing aids in their ear the audiologist may turn over management of this problem to the occupational therapist. Although the audiologist would still oversee the child's hearing healthcare, the audiologist would release this portion of patient management to the occupational therapist. According to Choi and Pak (2006), role expansion is when team members acquire new skills and function beyond their specific discipline. An audiologist may work on speech and language goals in an aural rehabilitation session after consulting with the speech language pathologist. On the other hand, a speech language pathologist might work on listening skills such as discrimination, identification, and comprehension exercises during a therapy session.

The professionals on the team may be varied based upon the needs of a child. Team members' involvement and responsibility for each child will vary based upon the child's specific needs (Wilson and Gleason, 2001). Particular team members may have an expanded role for child who has many needs which is within their particular scope of practice (Patel et al., 2008). In other cases their role may be more limited such as a child whose family has primary concerns not related to their profession or has lesser needs in the particular area of the professional's expertise (Wilson and Gleason, 2001). Thus, the team leader may be a professional from a distinct discipline for each child. All members of the team should be prepared to take the responsibility of being the leader when necessary. Membership is assumed to be one in the same with leadership on a health care team. Each professional is responsible for pulling their own weight on the team. Other team members assume that the professional will complete necessary work without the need for constant reminders and directions (Briggs, 1991). One responsibility of the team member is to understand the roles of the other professionals on the team. Each team member should have basic knowledge of the scope of practice of other team members.

One advantage of team care is that it tends to be comprehensive (addressing all the needs of the child) and family centered in nature (Patel et al., 2008). According to Wilson and Gleason (2001), decision-making is shared among team members. All team members are assumed to have equal power. Briggs (1991) found that equal power sharing may be more difficult for some professional to adopt who have traditional been established as power brokers based upon social and education esteem and superiority (i.e. physicians). In some cases, some members of the team may be intimidated by team members who they view as better educated or coming from professions that they view as

being more highly respected. It takes time for members of teams to build rapport and understanding (Briggs, 1991, Choi and Pak, 2006). The goal of the team should be to make all members feel comfortable enough to openly express their thoughts and opinions.

One challenge for a health care team is how to address disagreements about diagnosis, treatment, or intervention among team members (Wilson and Gleason, 2001). As stated earlier all team members should be willing to openly express their thoughts. Other team members have the right to critique these opinions in a constructive manner. Briggs (1991) reported that the team should attempt to build consensus when disagreements about treatment or interventions arise. Compromise and give and take will play an important role in the development of the team. It is crucial that a particular team member does not feel railroaded by other group members or that their thoughts and opinions are not valued. Team members may not always agree with each small detail or decision, but must buy into the overall decision about treatment or intervention.

Autism and Hearing Loss

Holden-Pitt & Albertorio (1998) revealed that 25-40% of children with hearing loss exhibit an additional disability. These additional disabilities include physical disabilities such as blindness or visual disabilities, motor disabilities (cerebral palsy), and intellectual disabilities and developmental disabilities (autism).

According to the Diagnostic and Statistical Manual of Mental Disorders Volume IV (DSM IV, 1994) autism is defined as a complex neurobiological disability that affects communication, social interaction, and behavior. Autism Spectrum Disorders encompass a wide range of behavioral and developmental characteristics. These disorders on the

spectrum include Autism, Asperger's disorder, Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS), Rett's disorder, and Childhood Disintegrative disorder (DSM IV-TR, 2000).

Diagnostic Criterion for Autism

The diagnostic criterion for autism was revised in 2000. According to the DSM IV-TR (2000), a child must meet six of the twelve characteristics within the three defined categories of the disorder (qualitative impairments in social interaction, qualitative impairments in communication, and restricted repetitive and stereotyped behaviors). At least two of characteristics must be within the category of impairments in social interaction (DSM IV-TR, 2000). The diagnostic category of social interaction includes the following characteristics: (marked impairment in the use of non-verbal behaviors(i.e. eye contact and gestures), failure to develop peer relationships, lack of spontaneous seeking to share enjoyment, and a lack of social and emotional reciprocity (DSM IV-TR, 2000). The qualitative impairments category includes the following characteristics: delay or total lack of development of spoken language, inability to initiate and sustain a conversation with others, stereotyped or repetitive language, and lack of varied spontaneous play or imitative play (DSM IV-TR, 2000). The final diagnostic category of autism is restricted repetitive and stereotyped behaviors. Characteristics included in this category are intense focus on a particular item, difficulty with changes in routines, repetitive motor movements (i.e. hand flapping), and persistent preoccupation with parts of an object (DSM IV-TR, 2000).

The Center for Disease and Control in the United States (2007) found that approximately 1 in 150 children have autism. Controversy exists about the sharp increase

in prevalence of autism over the past fifteen or so years (Singer, 1999). Most professionals theorize that the large increase in diagnosed cases of autism is due to increased public awareness of the disorder as well broadened diagnostic criteria.

Aims of the Paper

This paper intends to systemically review the literature related to autism and hearing loss. The object of this paper is to address how audiological services can be improved to serve the unique needs of children with autism and hearing loss. The paper will examine the audiologist's role in the initial diagnosis of autism as a member of multidisciplinary or transdisciplinary team. The transdisciplinary approach is a framework for allowing members of different professions to contribute knowledge and skills, and to collaborate and organize intervention services that will benefit the child (Rabidoux 2005). This approach greatly varies from a multidisciplinary team. Typically, in a multidisciplinary approach interaction between professionals is limited to phone calls and written notes (Patel et al., 2008). Other professionals providing services to the child are informed about the child's progress, but a team approach to treatment is not adopted. It is very rare that team meetings or combined therapy sessions between professionals are completed (Briggs, 1991). In addition, the paper will discuss the audiologist's responsibility when he/she observes developmental concerns during an audiological evaluation not within the team mode. This paper will provide recommendations on how to modify behavioral testing for children with autism or suspected of having autism as well address other considerations before testing begins. The interpretation and explanation of audiological results for children with autism will be examined. Recommendations will be provided on the process undertaken to complete follow-up

testing if the test results are incomplete/inconclusive. The final two section of this paper will focus on intervention for children with autism in areas of amplification and early intervention programs. Finally, the conclusion of the paper will provide recommendations for future studies in the areas of autism and hearing loss.

Review of Literature

Studies which examine the prevalence of hearing loss in children with autism have demonstrated a wide variation in findings (Rosenhall et al., 1999). Student and Sohmer (1978) found that all the children tested with autism in the study had hearing loss according to an auditory brainstem response (ABR) examination. Skoff et al. (1986) reported that 44-63% of children in their study had hearing loss and autism. Taylor, Rosenblatt, and Linschoten (1982) findings were similar to Skoff et al. (1986) with a prevalence of 44%. Other studies have found much lower prevalence. Novick et al. (1980) and Grillon, Courchesne, & Akshoomoff (1989) reported no hearing loss among children with autism in their studies and Gillberg, Rosenhall, & Johansson (1983) reported a prevalence of 13%. Klin (1993) reviewed all the studies on hearing loss and autism and reported that 33-46% of 170 subjects identified with autism had some type of hearing abnormality. It should be noted that many of these studies has extremely small sample sizes of less than 15 participants and most studies only included between 20-30 participants on average. In addition most studies utilized ABR as the determining factor of whether the child was labeled as having a hearing loss. Inclusion criteria and methodology was questionable in many of the studies as well. Rosenhall et al. (1999) tested 199 children with autism utilizing behavioral measures to evaluate hearing sensitivity that were appropriate for the child's developmental level and ABR (in 192 of

199 cases). This study found that approximately 8% of children had mild to moderate bilateral hearing loss (PTA 20-40 dB HL), 3.5% had either pronounced hearing loss (PTA 40-70 dB HL) or severe to profound hearing loss (PTA>70 dB HL), and 1.6% had unilateral hearing loss. In addition, Rosenhall et al. (1999) found that nearly 24% of the children in the study had serous otitis media when examined via tympanometry and/or otoscopically. The finding of 3.5% having a pronounced (moderate/ moderately severe/ severe/ profound) hearing loss is ten times higher than the normal childhood population. Braden (1994) found that profound hearing loss was only present in 0.1-0.2% of the normal childhood population. As written earlier, most estimates of hearing loss in children with autism used ABR as the main measure of hearing sensitivity. The estimates of children with autism and hearing loss that used ABR should be viewed with caution. Some of studies criteria for defining hearing loss included any ABR abnormalities such as increased absolute latencies or increased interpeak latencies of waves. In these cases hearing loss in children with autism may be greatly over estimated. Rosenhall et al. (2003) reviewed the previous ABR/Autism studies. These ten research groups all found at least some ABR abnormalities. The most common abnormalities included prolongation of interpeak latencies namely I-V IPL and I-III IPL. These findings should be considered with great caution because of small sample sizes and questionable methodologies (Rosenhall et al., 2003).

Much like any neurodevelopmental disorder early identification and intensive intervention is crucial for children with autism. The National Research Council (2001) found that the most important criterion for successful treatment outcomes for children with a disability is treating children at the earliest possible age and parental involvement.

In the case of child with a hearing loss and autism early identification of both disorders is paramount in determining appropriate intervention services and obtaining successful outcomes. Most families begin to express concern to healthcare professionals about their child's development before the age of two. Early diagnosis provides the child and the family access to early intervention services (Fombonne, 1997). These services are carried out by professionals in the naturalistic setting for the child such as the family's home (Sass-Lehrer, 2003). The goal of the professionals is not only provide services, but to model therapy techniques that can be conducted by the family within the home setting or in the community (Fombonne, 1997). Professionals attempt to educate the family and empower the families to make decisions. By empowering the family, the family feels more control over the entire process. This helps the family to buy into the treatment and provide the feeling of having a stake in the specific interventions. In a family-centered healthcare approach the family is an important member of the team. According to Sass-Lehrer (2003), it is the professionals' responsibility to educate the family on treatment recommendations for their child, but the family makes the ultimate decision about what treatments should be selected. It is crucial that professionals listen closely to the family during the diagnostic and treatment process. Parents know their child's unique characteristics as well as their strengths and weaknesses (Carney and Moeller, 1998). Often times the family's insight about a particular like or dislike or behavior may lead to different approach to diagnostic testing or therapy.

CHAPTER 2

AUDIOLOGIST'S ROLE IN IDENTIFICATION/ DIAGNOSIS OF AUTISM

On the surface it would seem that audiologists do not play that large a role in the diagnosis/identification of autism unless they are member of a multidisciplinary or transdisciplinary team. On the contrary, audiologists are often times at the front line of defense early in the assessment process. According to Rabidoux (2005), audiologists and/or speech language pathologists tend to be contacted early in the assessment process of children suspected to be on the autism spectrum because communication impairments are very visible to the family. Early identification and enrollment in an intervention program is paramount in a producing a better long term outcome for children with autism spectrum disorders . Thus, it is crucial that audiologists refer children that they suspect may have autism based upon parental report and observed behaviors to appropriate professionals in a timely fashion. Harris and Handleman (2000) demonstrated that the delivery of intervention services at a young age leads to increased social engagement and language use for the child diagnosed with autism. Furthermore, Singer (1999) found the development course is more pliable to change in children whose intervention services were initiated before age 4. It is important that audiologists have some knowledge of normal developmental milestones in the areas of cognition, motor development, and communication skills. Just because a child presents with normal peripheral hearing acuity does not mean that the professional responsibility of the audiologist ends.

Diagnosis of a child that is suspected of autism is a very complex process. These children often present with communication, social, and behavioral challenges that can impact the assessment process. With that in mind a transdisciplinary approach is considered the best practice when evaluating children with disabilities (Rabidoux, 2005). This model provides professionals, parents, and caregivers an opportunity to plan for the child's complex and specific needs. Within a transdisciplinary team disciplinary boundaries are less defined. Each professional still participates from their discipline home, but the ability to transcend disciplines is encouraged to get a clearer overall perspective of the child and family (Soskolne, 2000). It is crucial that team members let go of the medical model philosophy of the expert authority (Briggs, 1991). Instead, parents are viewed as the experts. Families play a crucial role in the decision making process and should never feel bullied or forced into a particular option by a team member or team members. Empowering parents to become experts and make decisions requires well coordinated planning among team members. Team members must explain diagnostic results and treatment in easy to understand fashion. Members of the team must learn what level of sophistication is required with each family (Rabidoux, 2005). In addition, team members must provide the family with resources to increase their expertise through mediums such as the internet, libraries, parent support groups, sibling support groups, and service centers which can provide specific resources about a particular disorder (Rabidoux, 2005). Strategies to make the family more comfortable and empowered through the clinical process can include a single source of entry through each clinic, participation of a parent advocate on the team, a team leader who becomes familiar to the

family and can assist the family with any questions, and flexible scheduling of appointments to fit the family and child's needs (Rabidoux, 2005).

The Diagnostic Process (Team Approach)

The transdisciplinary assessment team may include the following disciplines based upon the needs of child: psychology, audiology, physical therapy, occupational therapy, developmental pediatrics, speech-language pathology, family advocacy, nutrition, nursing, and dentistry (Patel et al., 2008). According to Briggs (1991) the transdisciplinary model is based upon consensus building, collaboration, and role release among participants. The goal of the transdisciplinary team is to determine a differential diagnosis through the use of diagnostic questions and procedures (Choi & Pak, 2006). It is important in the formation of the team that an agreed upon sequence of events is determined for the diagnostic process. The team should critically evaluate the diagnostic process and seek recommendations from the family to improve the overall process. These recommendations may help to improve the process and care received for future patients.

Rabidoux (2005) explained the typical sequence of events that leads to a referral for an evaluation at the Family Directed Clinic in which she works at. In most cases, the initial referral is from a pediatrician to an audiologist for a hearing evaluation. Children suspected of autism frequently exhibit auditory behaviors that would lead professionals and parents to be concerned about their hearing. In many cases, audiologists may be the first professional other than the child's pediatrician to have contact with the child (Rabidoux, 2005). If the audiologist determines that the child has normal peripheral hearing the next referral is typically to a speech-language pathologist for a

communication evaluation. In most cases if a referral is made to the speech-language pathologist a speech and language delay is likely to be diagnosed. During the course of therapy or the formal speech and language assessment the speech-language pathologist may observe difficulties with interaction and atypical play behavior. This would lead the speech-language pathologist to refer back to the pediatrician for a developmental assessment. At this point the pediatrician would refer on to a developmental assessment team to evaluate the child (Rabidoux, 2005).

The family would start the diagnostic process by contacting the clinical coordinator. During the initial contact the coordinator would discuss what concerns the family has about the child and why they are seeking an evaluation (Rabidoux, 2005). The coordinator would inform the family that they would receive paperwork in the mail to complete before the appointment. In addition, the coordinator would ask the family to bring any pertinent medical reports or history or ask the family to have those professionals send the reports. The coordinator would remain the person of contact for any questions or concerns of the family up until the appointment date. If needed the coordinator would assist the family with any transportation issues in getting to the appointment. The coordinator may assist the family in finding programs or community resources they can utilize before their appointment.

The Diagnostic Evaluation

On the day of the appointment the family will initially meet with the coordinator along with the team leader. The team leader typically is a member of the team and will take responsibility for appropriate follow-up questions and concerns (personal experience). In addition, the team leader will summarize the team's findings and

recommendations. The team leader will help the family in setting up interventions/therapies and connect the family to community resources (personal experience). Before the appointment the team leader compiles all the important reports and creates a file that can be accessed by other team members to gain important background information about the child. The coordinator collects insurance information and answers questions about diagnostic and therapeutic coverage (personal experience).

The team leader informs the family about the different evaluations that will be conducted and provides the family an overview of what to expect. Team members meet for an initial discussion of the child's background history. The plan for interviewing the family is discussed and the order in which the evaluations are conducted. Typically, the family interview is conducted by two to three team members and the other team members observe the discussion and engage the child (personal observation/experience). This engagement of the child is crucial because it provides team members' valuable insight into the child's temperament, helps the child to become comfortable with the surroundings and other team members, and provides some indication about the child's developmental level of functioning. Each team member then conducts their discipline specific diagnostic evaluation. In some cases team members may work together to complete a discipline specific evaluation or multiple evaluations may be worked on simultaneously (personal experience/observation). During the discipline specific evaluations the parents may be asked to complete a questionnaire related to the specific diagnosis that is sought for the child. After all the diagnostic evaluations are completed the team members meet to discuss their findings.

Team Meeting/Post-Diagnostic Evaluation

Each team member explains the diagnostic evaluation they conducted and the results of that evaluation. Once all the team members have explained their results the team member begin to discuss overall impressions and diagnoses. The team then begins to discuss overall impressions to see if the child meets the criteria for an autism spectrum disorder (personal observation/experience). Autism can be diagnosed by a physician or a psychologist. Typically, the developmental pediatrician or the psychologist will go through the testing and characteristics that must be met to be diagnosed with an autism spectrum disorder. During this discussion it is crucial that each team member provide insight about the child's behavior. Once a definitive diagnosis is established each professional reviews their findings and creates discipline specific interventions (personal experience/observation). Throughout the process having a good rapport and working relationship with other members of the team is crucial.

Boundaries for each discipline can be rather fluid. In some cases, other professionals along with the audiologist may work with the child on listening and hearing skills. If aural rehabilitation therapy is being provided the audiologist and speech language pathologist will likely have a very close working relationship. Many times overlap may exist in skills being taught or learned during aural rehabilitation therapy and speech language therapy. Although the audiologist may be working on listening skills the child's needs language to respond to the particular command. In the case of speech therapy, listening plays a crucial role in the ability to produce appropriate speech and language utterances.

Team members may need to work together in coordinating and scheduling interventions. In some cases members of different disciplines may work together to provide intervention services. The meeting concludes with the team leader reviewing all of the diagnoses and recommendations. In addition, members of the team examine funding sources for the family based upon location, income level, transportation availability, and family need (personal experience/observation).

Explanation of Diagnostic Results to the Family

Each team member presents their findings and recommendations to the family. The family is encouraged to ask questions or ask for clarification if they do not understand a diagnosis or recommendation. After all the diagnoses and recommendations are shared with the family the team leader summarizes the findings and intervention plan (personal experience/observation). The family is provided a summary sheet which explains the diagnoses and recommendations. That provides the family a framework for the plan and can be a leading off point for later questions. The next step is to explain the intervention services and therapy is clearly laid out. At this point, the parent advocate provides information about the diagnosis and services recommendations from a parental perspective. The parent advocate may provide brochures about the diagnosis, information about parent and sibling support groups for autism, legal and educational rights for their child, helpful websites, and information about other valuable community resources (personal experience/observation). If the parents indicate understanding of the diagnosis and recommendations the appointment concludes. The team leader provides contact information if questions arise for the family. It is responsibility of the team leader to follow-up with the family and to see if the family needs assistance in carrying

out recommendations or still has questions (personal experience/observation). Each member of the team completes their discipline specific report and an overall diagnostic report is created. This report is sent to the family and any other professionals that will be involved in the treatment services for the child (personal experience observation).

From this point on the diagnostic team's involvement will depend largely on the role of the team. In some cases team members may be a part of the intervention team, while in other cases the diagnostic team may simply make its recommendations and refer the child on to other professionals based upon the needs of the family and the child.

CHAPTER 3

SPECIAL CONSIDERATIONS DURING THE AUDIOLOGICAL EVALUATIONS

It is crucial the audiologist understands that a child with autism is a child first and foremost. Just like any other child each child with autism will have unique likes and dislikes. Although specific behavioral characteristics of autism are well defined no two children with autism will behave in the same manner. This section will provide some suggestions on how an audiological evaluation, specifically behavioral testing can go more smoothly.

One recommendation which can greatly help the audiological process is knowledge of any medical diagnoses or suspected disabilities. In the case of a transdisciplinary team evaluation there is knowledge of a possible neurodevelopment disorder based upon the parents and physician requesting an evaluation. Having prior knowledge about a child's disability and behavior will allow the audiologist to establish a plan for testing. If it all possible the individual who schedules the appointment should ask the family if the child has been diagnosed with any disabilities or suspected disorders. It may be suggested to the family that they should attempt to desensitize their child to headphones if they child has sensitivity issues. Depending on the age of the child some practice listening games could be tried before the appointment. If developmental history is not obtained before the appointment it can be gathered through a case history form or a

parent interview. Gaining knowledge about the child's idiosyncrasies and behavior is crucial for a successful audiological evaluation to occur.

Cloppert and Williams (2005) remarked that several of the most common characteristics of children with autism that should be considered during audiological testing include sensory sensitivities, anxiety, difficulty with language comprehension and usage, and hyperactivity. David and Stiegler (2005) stated that audiologist is an unfamiliar face and voice to the child with autism. As a result the child may be more fearful and resistant to novel stimuli. The audiologist must understand that the parents of children with autism are already under considerable stress. When the parents observe their children not reacting to environmental sounds or their child not responding to someone calling the child this adds to the stress that something else may be wrong with their child. It is important that audiologist gain the crucial case history but do it a manner that does not make the parents even more uncomfortable. In addition, Cloppert and Williams (2005) pointed out that parents of children with autism are often times sleep deprived because these children may have atypical sleep patterns which interfere with getting a good night's rest.

Considerations Before Behavioral Testing

In addition to earlier questions about developmental delays when scheduling the appointment the family should be asked about how the child reacts to a new situation. According to Cloppert and Williams (2005), other considerations may include how well does the child separate, how comfortable is the child in an enclosed space, does the child take medication that may impact testing (behavioral or electrophysiologic), is the appointment time in conflict with the child's nap or eating schedule or when their

medication may be wearing off. Often times children with autism struggle with new environments and are fearful of transitions. If this is the case for a particular child who is scheduled for an appointment it may be a good idea for the child to be exposed to the testing site with a short visit to the facility to make the location more familiar. In some cases a child may need a couple mini-exposures to prepare for the testing (Cloppert and Williams, 2005). Another consideration may be providing the child exposure through books or other media. Cloppert and Williams (2005) suggested the use of a picture book or a video presentation to help the child and family feel more comfortable with the process.

Another possible idea for the child to gain comfort is the use of story board. This story board could be a poster, a magnetic board, or felt board. Each step will be represented by a picture or symbol. To prepare for the appointment the family could be given a kit. A few days before the appointment, the family could talk about the different steps so the child knows what to expect. In some cases the family may even act out some of the steps. It might be a good idea for the child to practice wearing headphones. Games in which the child reacts to sound by either stopping their action or turning toward sounds may be useful. If necessary the child may want to bring the board with them or smaller version. As the child completes a step they could place the picture/symbol on the board or use a checklist to indicate that the step was completed. At the completion of each step the child may receive a small tangible reward such as a sticker or a small snack.

Order of Events (Audiological Evaluation)

Audiologists typically start by doing an otoscopic examination and immittance measures after gathering case history. Some children may get very upset when their ears

are manipulated. The audiologist should check with the parents if the child gets very upset when a physician looks in their ears. If the child tends to get agitated and upset it may be a good decision to conduct the otoscopic examination and immittance measures after the behavioral evaluation. This allows the child to enter the behavioral testing in a good state of mind rather than being upset and fearful. Like any other protocol some exceptions may exist. If the child has history of recurrent otitis media with effusion or ventilation tubes in place the audiologist may want to complete tympanometry if they believe that the child will eventually calm.

Some audiologists may want to obtain OAE results before behavioral testing to get an estimation of the child's hearing sensitivity. Grewe et al. (1994) found that OAEs are a valuable tool in the assessment of the children with autism. Although present OAEs does not necessarily correlate to normal peripheral hearing sensitivity these results can serve as crosscheck to help assess the validity of the obtained behavioral results (Harris and Probst, 1997). Further, Gravel et al. (2006) found no significant difference in OAE measures for children with autism/normal hearing and the normal developing/normal hearing control group. Outer hair cells are thought to be the primary generators of OAEs (Moore and Linthicum, 2001). In addition, the presence of OAEs suggests that the cochlear amplifier is intact. The cochlear amplifier is thought to enhance the sensitivity and frequency selectivity of inner hair cells at low and moderate sound levels (Lonsbury-Martin, Martin, and Telischi, 1999). Thus, Gravel et al. (2006) findings suggest that the cochlear mechanism responsible for sensitivity, frequency selectivity, and dynamic range of the ear is identical in children with autism and their normal developing peers.

Environmental Considerations

Audiologists probably do not think much about the impact of the environment on testing. Things such as the design of test booth, the amount of lighting, and reinforcement toys likely are not items audiologists think about much during the testing of adults and children without disabilities. These all may be very important considerations when testing a child with autism. Checking with the parent about likes and dislikes may be the difference between obtaining valid responses and having the child so upset they can not continue after viewing the reinforcing toy. To avoid these dilemmas during the case history or before the testing begins the audiologist should check with the parent about specific sensory stimuli that may upset the child. Maybe the toy should just be lit up instead of running the motor which may scare the child. In some cases the child may be more comfortable with a lighter or darker environment in the test booth. During most VRA testing audiologists tend to avoid letting the child hold a toy or object, but for some children with autism it may provide comfort and actually allow them to focus better. In addition holding the object may serve as a way to avoid having the child taking off the headphones.

One final consideration of the environment is seating. If the child simply does not want to sit on their own it may be appropriate from them to sit on their parent's lap. Special considerations for the type of seat may be necessary as well. Cloppert and Williams (2005) remarked some children with autism need the sensory input of their feet touching the ground. A chair that is too high or wide may make the child feel uncomfortable. The use of an elementary classroom chair may help the child feel more grounded.

The Method of behavioral testing

The type of behavioral testing should be determined by the child's developmental age. Behavioral observation audiometry (BOA) is typically practiced for children less than 6 months of age and minimal responses are determined by the child's reflexes to auditory input. Visual reinforcement audiometry (VRA) is for children who function between 6 months and 3 years of age. Conditioned play audiometry (CPA) is typically conducted for children ages 3 and above (Northern and Downs, 2002). Again, flexibility is crucial. Some children may be at a lower developmental age, but may be able to complete a higher level task. In some cases a combination of testing techniques can be utilized. When children are approximately two years old some audiologists utilize a combination of VRA and Play Audiometry (personal experience/observation). The child is still positioned between the speakers and turns to the speech or tones and is reinforced for a response. In some cases the audiologists on the test side or the assistant may complete a play task such as placing a peg in a board after the child's response. In other situations after the child turns to the stimuli they may be given the peg to the place in the board. This combination game helps transition the child for the next higher level of testing (personal experience/observation). If the child is tested again due to incomplete results or has a hearing loss the child is better prepared to move to the next task as they age (personal experience/observation). Audiologists should take special care to indicate the type of testing method utilized on their report as well as if any modifications such as a combination mode of testing were used.

Interaction and conversation with the patient can play a crucial role in making sure that the patient is at ease and performs to the best of their ability during testing.

Children with autism may have a specific or favorite topic they want to discuss. Some audiologists may avoid discussion of the topic for fear that the child will get off track. Cloppert and Williams (2005) suggested that it may be useful to briefly discuss the topic for a minute or so and acknowledge any familiarity with the particular subject. This method has two motives. First, the tester and the test assistant in the booth build rapport with the patient. Secondly, the child will feel relaxed in an unfamiliar and intimidating setting. Cloppert and Williams (2005) stated that in addition to the initial conversation that a promise to talk about the favorite subject after the hearing evaluation could prove to be a valuable incentive.

The Behavioral Evaluation

One of the first decisions the audiologist must make is whether to start testing in the soundfield or under earphones. For young children under the age of three most audiologists will begin with soundfield testing and progress up to earphones to obtain ear specific information. In some cases an audiologist may begin with earphones if they have already received accurate soundfield testing from a previous evaluation. There may be a rare case in which the audiologist begins with earphones for a young child because of concerns about limited attention and time to obtain results. It is important no matter what approach the audiologist and parents realize that a few appointments may be necessary to obtain ear and frequency specific data.

Another consideration is the use of supra-aural headphones versus insert headphones for testing children suspected or diagnosed with an autism spectrum disorder. It is well established that children with autism have sensory issues (Fombonne, 1997). These sensory issues can include the head and ears. Some audiologists argue that insert

earphones are less heavy than TDH headphones and more comfortable for the patient. In addition, the use of masking is typically needed less with insert earphones. Insert earphones help to avoid a collapsing canal which can artificially inflate high frequency responses (Lilly and Prudy, 1993). Disadvantages of the insert earphones can include less accurate results in children with pressure equalization tubes in the low frequencies (Tokar-Prejna and Meinzen-Deer, 2006), the foam tip being occluded by wax, and the child being annoyed by something being clipped onto their clothing. In addition, some children may view insert earphones as invasive and do not like the feel of them sitting in their ear canal. Again flexibility is crucial. Ask the parent if the child has specific sensitivity issues related to their head or ears. If the child practiced at home with supra-aural earphones before the testing then the use of TDH headphones may be a better option. On the contrary, if the child likes to listen to music via ear buds they may be more comfortable using insert earphones.

When testing children most audiologists will typically begin with obtaining a Speech Recognition Threshold (SRT) or Speech Awareness Threshold (SAT). After obtaining this information the audiologist will continue on to pure tone testing. Different strategies exist for obtaining pure tone results. When testing under earphones some audiologists like to start with a high frequency (4000 Hz) and then test a low frequency (500 Hz). Some advocate switching between ears while others like to get some full information about one ear. The sequence of testing is not that important as long as all the data is obtained during that test session or in future test sessions.

If soundfield testing is completed this paper advocates attempting at a minimum an ear specific SAT/SRT. Tharpe et al. (2001) found that children with autism and

hearing loss are often not diagnosed until 3 years of age. This is likely because unilateral and mild hearing losses may often be missed. This provides the audiologist some information about the patient's hearing sensitivity for each ear in the speech frequencies and helps to avoid missing a unilateral hearing loss.

CHAPTER 4

INTERPRETATION / EXPLANATION OF THE AUDIOLOGICAL EVALUATION

The interpretation and explanation of the results is a significant part of hearing evaluation. Results should be presented in a clear and concise fashion. The family should be given plenty of time to ask questions or express concerns. Audiologists should avoid the use of discipline specific jargon and instead use easier to understand lay person language. Substitutions such as pitch for frequency and loudness for intensity are much easier for parents to understand. Recommendations and interventions should be given verbally as well in a written form.

Explanation of Results (Normal peripheral hearing)

If normal peripheral hearing acuity has been established and no developmental difficulties were reported by the parents/caregivers or observed by the audiologist it should be recommended that the parents only seek a re-test if concerns arise. The audiologist should inform the parents that the child has sufficient hearing to develop speech and language.

If the child seems behind in speech and language development the audiologist should refer to a speech language pathologist. It is crucial that audiologists have general knowledge about speech and language development and milestones.

Explanation of Results (Normal Hearing/ Development Difficulties)

Again the audiologist should explain to the parent that normal hearing sensitivity was established for both ears. If the audiologist observed developmental/behavioral delays during the evaluation or the parents reported concerns the audiologist should inquire about other upcoming evaluations. The audiologist should make a referral to a developmental pediatrician or a psychologist for a behavioral evaluation if not already scheduled. Cloppert and Williams (2005) recommended that the audiologist express these concerns to the parents and place the concerns in a written report. This is especially important in the case of first time parents that may have less knowledgeable about what constitutes normal development. Because hearing is one of the first things checked it is crucial that audiologist make appropriate referrals when necessary.

Auditory behaviors that may provide clues that a child has autism include hypersensitivity to sounds, difficulty hearing or responding in the presence of competing message (i.e. background noise), difficult with processing auditory information, and unresponsiveness to certain verbal commands and/or environmental sounds (Taylor et al., 2002, Khalfa et al., 2002, Gomot et al., 2002, Condon ,1975, Novick et al., 1980, & Wetherby, 1981). It should be noted that some children with autism do not demonstrate any auditory difficulties. Thus, audiologists should be aware of non-auditory signs and symptoms. These symptoms may include speech/language delays, pragmatic language difficulties, concern with developmental milestones, regression of developmental milestones, perseveration on speech or environmental sounds, playing by oneself, lack of interaction with peers, avoidance of eye contact, self-stimulating behaviors (arm flapping, rocking, touching of things in environment, tactile defensiveness, and a selective food

eater (DSM-IV 1994). If some of these behaviors are observed or reported by the parent during case history the child should be referred for a developmental/behavioral evaluation. Egelhoff et al. (2005) recommended that audiologists should be acquainted with local resources to make an appropriate referral. A referral sheet which list professionals from different disciplines in which the audiologist or clinic has a working relationship is a helpful tool for the parent and the professional. Eglehoff et al. (2005) suggested that pediatric audiologists may want to visit an autism intervention center in the area. This will provide the audiologist the opportunity to observe children diagnosed with autism and have greater insight into signs and symptoms of the disorder.

Identification of hearing loss

Counseling the family after identifying hearing loss in a child with autism in many ways will be similar to any counseling session following a new identification of hearing loss. The reaction of the family to the hearing loss will likely be similar to families whose child are diagnosed with hearing loss and have no other disabilities. Cloppert and Williams (2005) cautioned that some families may ascribe some or all of the child's developmental delays to the newly diagnosed hearing loss. The audiologist should counsel the family that it is important to continue with the rest of their diagnostic evaluations. In the case of a team approach to testing each assessment is carried out to get an overall view of the child's functioning. If the family was tested in an audiology clinic and not part of a team evaluation the audiologist should encourage the family to complete the other diagnostic evaluations as scheduled (Cloppert and Williams, 2005).

Some families may react very negatively to an additional diagnosis of hearing loss. In some cases families may challenge the reliability and accuracy of the test results.

The audiologist should re-iterate to the family that they are confident in the reliability of the child's responses (Cloppert and Williams, 2005). A re-test could be utilized if the family continues to cast doubt about the accuracy of the test

The family may need more time to process the results and gain acceptance of the disability. Providing the family handouts about hearing loss, amplification, and programs for children with hearing loss can be helpful when the family begins to accept the diagnosis. In some cases the family may return at a later date to discuss test results and amplification options. Families may vary across a wide spectrum in terms of acceptance and therapy options after the diagnosis. Some families may be prepared to select hearing aids based upon the audiologist's recommendations and make earmolds soon after the diagnosis. Other families may need a few days or weeks to get over the initial denial stage in coping with the diagnosis of hearing loss. Wherever the family is on the continuum it is important that the audiologist is respectful of the family's feeling and needs, but still actively pursuing appropriate amplification and therapy options for the child.

Inconclusive/ Incomplete results

When testing young children audiologists often are put in the position of interpreting incomplete or inconclusive results. The gold standard for behavioral testing is obtaining SRT/SAT for both ears, word recognition at a supra-threshold level (if appropriate for the child's age), and ear and frequency specific pure tone thresholds. If incomplete or inconclusive results are obtained the audiologists must determine what the best course of action is. Decisions such as how soon to re-test, is there enough information to justify fitting the child with amplification, and should therapy begin must

be determined. Unfortunately, children with disabilities can slip through the cracks when it comes to getting complete audiologic results for a myriad of reasons. One reason is that the child has behavioral difficulties during the testing and the audiologist does not recommend follow-up testing until the child is older. The parents may forget about the recommendation and the appropriate follow-up does not take place. In some cases the audiologist may state that the child has normal hearing utilizing incomplete results or the parents will miss interpret the results reported by the audiologist and not seek a follow-up evaluation. This is why it is imperative that the audiologist explain the results clearly to the parent and clearly explain all diagnostic results and evaluation to other professionals in their reports.

Davis and Stiegler (2005) conducted a chart review to assess the implications of audiologic test data on future evaluations and interventions for 15 children with autism over a 7 year period at a university clinic. The study found that parents were told that the child had normal hearing appropriate for speech and language development with only minimal or incomplete audiological data. Unfortunately, in some cases incorrect assumptions were made by other professionals based upon the audiologist's report. Davis and Stiegler (2005) found over one half of the children in the study had reported chronic otitis media and one set of pressure equalization tubes. Despite this fact, middle ear assessment was documented in less than one-half of the children with chronic otitis media before enrollment in therapy. In 60% of the cases, other professionals transferred audiological information into future evaluation and reports. It was reported that at times other professionals made incorrect interpretations that appeared in their report or a

misleading finding by an audiologist was placed in a report by another professional (Davis and Stiegler, 2005).

Furthermore, Davis and Stiegler (2005) uncovered some dangerous interpretations based upon incomplete or inconclusive data. A couple of these cases included obtaining normal responses in the soundfield and making no further recommendations for testing and completing only OAE testing which was normal bilaterally and not recommending any further testing. In the first case the audiologist should have recommended further behavioral testing until ear and frequency specific information could be obtained. As for the second case, present OAEs are not enough to say that peripheral hearing is definitively normal. Although typically rare, OAEs can be present in an individual with a mild hearing loss (Harris and Probst, 1997). Additionally, OAEs can be present in children with auditory neuropathy or auditory dyssynchrony (Deltenre et al., 1999).

Children with auditory neuropathy/auditory dyssynchrony have normal OAEs but abnormal ABR results. These individuals have poorer than expected word recognition scores as well (Deltenre et al., 1999). Typically, word recognition measures are completed on children three years and older. As a result, audiologist must be careful when drawing conclusion based upon OAE test results alone in the under three years of age population. Further behavioral testing should have been recommended to confirm that the child had normal peripheral hearing. If behavioral testing can not be completed an ABR may be considered to assess hearing sensitivity. In some cases the child may need to be sedated for the ABR.

In summary, when testing children especially those with autism audiologist may obtain incomplete or inconclusive test results. It is essential that the audiologist utilize their professional judgment and make appropriate recommendations. The goal standard of behavioral testing includes pure tone testing, obtaining an SRT/SAT, and word discrimination at a supra-threshold level (if age appropriate). If the audiologist does not obtain all of that information further behavioral testing should be recommended. In some cases these recommendations may call for testing at a later date to allow the child to mature. A recommendation to re-test after an extended period of time say greater than 6 months should be used with extreme caution. For example, if a 2 ½ year old child with no red flags or major parental concerns had normal response to tones in the soundfield and a normal SRT it may be appropriate to wait 6 months to obtain ear specific thresholds. On the other hand, a 1 ½ year old that only provided a normal soundfield SRT would warrant more immediate follow-up.

Audiologists need to clearly explain the results to the parents and what test results still need to be obtained. Recommendations should be presented to the family, but ultimately it is the family's decision on how to proceed. If the audiologist has concerns about the child's hearing due to family history of childhood hearing loss, medical indications, or their own observation they should strongly encourage quick and thorough follow-up testing.

CHAPTER 5

INTERVENTION CHILDREN WITH HEARING LOSS/AUTISM

Amplification

Fitting a child with hearing aids that has an additional disability can be very challenging for the audiologist. Some of these challenges may include what impact does an intellectual or motor disability have on insertion, manipulation, care, and overall use of the hearing aids, if the child has speech and language difficulties how will they inform a parent/teacher/teacher's aide/caregiver that their hearing aid are not working correctly, should these children be treated differently from typically developing peers in items such as fitting strategies and time of use. Tharpe et al. (2001) conducted a study on the fitting practices of children with hearing loss and an additional disability. The survey asked respondents specific questions about the fitting practices for this special population and classified children within the following categories: vision impairments, intellectual disability, physical disability (cerebral palsy), and autism spectrum disorder. These disability classifications were compared to children with hearing loss. Tharpe et al. (2001) revealed that children with autism typically were not fit until 3-5 years of age, while children in the other disability categories tended to be fit around 12 months. There are a couple plausible explanations for the much later fitting of children with hearing loss and autism. One explanation is that the difficulty obtaining behavioral results may result in mild and unilateral hearing losses being missed. As written earlier, this could be the

result of an audiologist drawing an inappropriate conclusion from incomplete or inconclusive data or a lack of follow up testing because the parents were not concerned. Another explanation is that child's behaviors related to their autism resulted in their hearing difficulties being masked or ignored.

Tharpe et al. (2001) examined the type of verification measures utilized by audiologist in fitting children with hearing loss and an additional disability. Verification measures varied by age but not by class of disability. An equal number of respondents utilized behavioral measures (soundfield aided thresholds, aided SRT/SAT, and aided word recognition measures) or some type of real-ear microphone measure. As the child's age increased traditional real-ear microphone measures such as speech mapping were utilized over Real-Ear Couple Difference (RECD) measures. Overall, Tharpe et al. (2001) found little differences in the fitting and selection process for children with multiple disabilities than children with just hearing loss. In some respects this can be seen as a positive that audiologists are more willing to fit patients with multiple disabilities. The drawback to fitting children with multiple disabilities in the same manner as children with normal development is that these children often participate in very different activities than their peers who only have hearing loss. Typically, these children have unique and specific needs that differ from children with hearing loss alone. The challenge is how audiologists create appropriate outcome measures for children with multiple disabilities and hearing loss that measure progress. Traditional behavioral measures may not be appropriate for some children with multiple disabilities.

Fitting Considerations

Special considerations should be taken into account when fitting a child who has a hearing loss and additional disability or disabilities. It is vital that the audiologist understand what areas of functioning are strengths and weaknesses. Knowledge of the child's cognitive, communicative, and motor skills will help guide the fitting and rehabilitation process.

For example, if the child has difficulty with fine motor control the style of the hearing aid should be a consideration. In nearly all cases, a behind-the-ear (BTE) hearing aid is recommended for children. BTEs are recommended for children from both a functional and economic perspective. From an economic perspective it is much cheaper to replace an earmold as the child grows rather than modify the case of a custom instrument. The functional advantages of a BTE for children include better compatibility with FM technology and greater programming options. In some cases if a child has poor fine motor control an in-the-ear hearing aid may be a better option, especially if the child is older. Consider the case of a child who has cerebral palsy and autism and struggles with fine motor control of small objects. Manipulating both the earmold and the hearing aid and placing them in the ear could prove to be extremely difficult. In addition if the child is in a wheelchair with a high back for head support feedback could be an issue with a BTE. Luckily, the problem of manipulation could be averted by the help of parents, sibling, home health assistants, teacher's aides, or other support personnel who could provide assistance or be responsible for placing the hearing aids in the ears. Plans can be created to help ease the manipulation difficulties as well. For example, if the child can put the hearing aids in correctly but experiences some difficulty a plan of action can be

created by the audiologist and carried out by the teacher's aide or classroom teacher. The plan might call for the child to attempt putting the hearing aids in a few times. If the attempts to put the hearing aids in prove unsuccessful then the support personnel will put the hearing aids in the child's ears. In addition, the support personnel will check to make sure the hearing aid and earmold are in the ear correctly. As the child enters adolescences and becomes more independent a custom instrument may be a better option if the child receives less classroom or home support.

Motor Disabilities

Considerations for a child who has a disability which involves motor control go beyond just putting and taking the hearing aid out of the ear. If the child has multiple programs can they push the button to change programs or do they need the assistance of a caregiver/support personnel? It is crucial that the audiologist educate the parent, child, and any support personnel about the different hearing aid programs and when it is necessary to manually switch programs. Higher end digital technology often times includes automatic program switching based upon the hearing aid's interpretation of the listening environment. This can be especially helpful if the child has more limited support in the school or home environment or if the parents/ support personnel do not have a strong grasp of when to switch programs. If the child is unable to perform the physical manipulation of changing programs, but knows when they need to change programs a plan can be created for a teacher's aide or even a buddy in the classroom to help them change programs. It might be a good idea to consider an automatic telecoil to ease phone conversation as well. As with other considerations proper training of the support personnel and flexibility are vital. Some days the child may have an off day and

need a greater level of support in putting the hearing aids in the ears and manipulating the hearing aid. On other days the teacher's aide may only need to check that the hearing aid is in the ear correctly. Obviously, motor disabilities do not always occur in isolation the child may have cognitive and communicative troubles in the addition to their motor disability. In this case special planning with team members managing the child is critical. The audiologist should take on a role of leadership on the team. The creation of a presentation which explains hearing aid functions and care may be helpful for the student's support staff.

Intellectual and Communicative Disabilities

The majority of children on the autism spectrum have an intellectual disability. Most of these children fall in the mild to moderate range of intellectual disability. The fitting and rehabilitation process will likely need some modifications for a child who has an intellectual disability. As the leader of the team it is crucial that the audiologist educate and empower the child and the family. Individuals with mild to moderate intellectual disabilities typically live in the community and levels of independence can range on a continuum from very little support up to more moderate levels of support. Just because an individual has an intellectual disability one should not assume that the individual will not understand your instructions or be able complete tasks independently. Instead, the language and steps may need to be simplified. In addition, the individual may need significant practice and rehearsing to learn how to complete a task. If the task is broken down into smaller steps the individual will likely understand and learn the task in a quicker fashion. The individual should be provided with reinforcement and encouragement as they learn to complete each step of the task. Hopefully, this will allow

the individual to gain confidence with each step and eventually gain competence in completing the task. Although a particular period of time may be devoted to learning an individual step it is vital that each step is built upon. In other words, the other already learned steps should be practiced at the end of the learning sessions even if the focus was one particular step for that time period. This demonstrates if the individual is retaining what they learned from the previous tasks. In addition, it provides an overall picture to the individual how each step fits together to complete the particular task.

For some audiologists it may be difficult for them to know what types of task an individual with an intellectual disability is capable of completing. This is where the team approach is critical. Reports from the psychologist and school officials should help to provide information about cognitive as well as functional capabilities. In addition, interviews with the parents and other support personnel should help the audiologist gain some general knowledge of the child's functioning. There is nothing wrong with setting high expectations for a child with an intellectual disability. With the right direction and teaching these children often surprise their teachers and parents alike. If the learning of a task does not go as expected modifications can be made or extra support added. Social stories, story boards, and checklists can help the child to both learn and remember how to complete particular steps of a task. For example, one of the goals for eight year old child with intellectual disability may be to correctly place their hearing aids in their ears when they wake up in the morning. The child still struggles with actually putting the hearing aids and earmolds in their ear correctly, but they know to seek assistance from a school support personnel or parent. The individual should reinforce what the child did well and view this as a learning opportunity for the child. If the earmolds were put in correctly or

nearly correct the child should be reinforced and praised for what they did well. The instructor should then proceed to review how to complete the rest of the task. Even if the child did not carry out any of the steps correctly they should be praised for their attempt and redirected on how to complete the task. Using this time as a learning opportunity instead of completing the task helps to empower the child and foster independence. In the real world time constraints may make it difficult to re-teach the child the task. Parents may be in a rush to get their children ready for school or the school support personnel may need to quickly complete a task so the child does not miss a significant instruction or a special presentation at school. Much like any child with normal intellect parents and teachers are forced to occasionally complete a task for a child due to time constraints. If the parent or school support personnel must complete the task they should praise the child's attempt.

Hearing Aid Troubleshooting Intellectual/ Communicative Disabilities

Another concern for a child with an intellectual disability and amplification is what happens if the hearing aid is not working properly. Once again it is crucial that the audiologist gather information from the other team members to determine the child's functioning and communicative level. Some children may simply be able to tell the teacher or teacher's aide that their hearing aid is not working. For other children with an intellectual disability it may not be so simple. In some cases the child may not realize that the hearing aid is not working appropriately. For these children it is crucial that the teacher's aide and teachers watch behaviors very closely. If a child seems to be acting differently it may be a good idea to check the functioning of the hearing aid and/or FM System. In other cases the child may have the intellectual capacity to know the hearing

aid is not working but lack the communicative skills to express this. For example, a child who has autism and is non-verbal may know that the hearing aid is not working correctly, but can not express their needs in verbal manner. Modifications can be created to provide support to a child in this situation. One solution is that the child is given a green and red piece of felt. The child is taught that if the hearing aid is not working they should hold or point to the red piece of felt. This red piece of felt informs the teacher or teacher's aide that the hearing aid is not working properly. In addition, this solution could be utilized for children who are embarrassed or too shy to interrupt the teacher that their hearing aids are not working properly. If the child displays the red felt the teacher knows how to troubleshoot the hearing aid or to whose attention the child should be directed to.

Modifications to the plan for care and maintenance may be necessary for a child with an intellectual disability. In some cases the child may be unable to complete tasks such as changing the battery or cleaning the hearing aid. Typically, as the child ages children take on more responsibility with the care of their hearing aids. Often times, this can be the case for children with intellectual disabilities as well, but these children may pick up on the task at a slower pace than their typically developing peers. In some cases the child's role in care of the hearing aids may be more limited due to safety concerns such as battery disposal. Again as stated earlier it is important to empower the child and provide them the opportunity to succeed even if their role in the care plan is extremely limited. The larger the role the child has in the hearing aid plan the more invested he/she will be in wearing and being responsible for the hearing aids.

Hearing Aid Features/Programming Considerations (Intellectual/Communicative Disabilities)

Earlier in this paper the impact of a motor disability was discussed on how that may affect manipulation of the different hearing features. In addition, the audiologist must be aware of how an individual's intellectual disability or communicative disability could impact the selection and use of certain hearing aid features. Some individuals with an intellectual disability may be perfectly capable of knowing when to switch programs or adjust their volume control. On the other hand, individuals with more severe intellectual disabilities might not possess the understanding of when they should switch programs, how to switch programs, how they know what program they are currently in, or how to adjust the volume control. As stated earlier, it is crucial that the audiologist seek out opinions of the professionals most involved in the treatment of the child. These experts can provide input into about the child's intelligence and functional skills. This information should help the audiologist determine if things such as an active volume control wheel or multiple programs are included on the hearing aids.

If the team determines that the child does not have the skill to make appropriate decisions about hearing aid manipulation and uses there are several options. One option is to select a more advanced hearing aid in which automatic program switching is enabled. This would help to remove concern about appropriate switching of programs in different environments. If a less advanced hearing aid is selected another option is for someone to switch the program for the child based upon the situation. For example, the helper would manually switch the program from the base program to the noise program when the child transitions from the classroom to the lunchroom cafeteria. For some children with

intellectual disabilities it may be necessary to disable all control over the hearing aids and even order a tamper resistant battery door. For some children who are in their adolescences or late teen years they like having the ability to adjust the volume when in different environments. If it is determined that a volume control will be enabled on the hearing aid the audiologist must pay particular attention to the range of the volume control. Even if volume control is enabled teacher and/or teacher's aide should be careful to observe the child and make sure appropriate adjustments are being made. When these individuals observe a child who looks uncomfortable or is not paying attention it might be a good idea to suggest that the child adjust the volume up or down.

Cochlear Implants and Autism

This section will briefly discuss children with autism who have a cochlear implant or cochlear implants. Edwards (2007) remarked that the criterion for cochlear implant implantation candidacy has expanded to include children with multiple disabilities and complex needs. Holt and Kirk (2005) found that children with intellectual disabilities made progress in speech perception skills after implantation, but at a slower rate than their normally developing peers.

A cochlear implant plan can be created similar to a hearing aid plan discussed earlier in the paper. Many of recommendations and structure will be the same as the hearing aid plan. Obviously, some differences will exist between the plans such as listening checks. For example, direct listening checks can not be completed on cochlear implants like hearing aids. Instead, the teacher's aide or support personnel should be informed of specific troubleshooting techniques for cochlear implants. These techniques

may include understanding how the warning lights help to determine the functioning status of the cochlear implant and how to re-charge cochlear implant batteries.

CHAPTER 6

EARLY INTERVENTION

Elements of an Early Intervention Plan

Early identification and rapid enrollment in an intervention program are crucial for a child with hearing loss and their family. With newborn hearing screening the goal is that hearing loss can be diagnosed before six months of age. Unfortunately, children with hearing loss and an additional disability are often diagnosed at a later age for a variety of reasons. Sometimes the child passes the newborn hearing screening, but they truly have a hearing loss. In other cases, the child may pass the newborn hearing screening but may acquire a hearing loss due to trauma, middle ear abnormalities not determined at birth, genetic progressive hearing loss not present at birth, certain types of chemotherapy treatment, or hearing loss acquired is after birth which is sometimes the case in children with enlarged vestibular aqueducts. The hearing loss can be missed because professionals and parents were more concerned about the failure to develop other functional milestones. For all of these reasons a child with a hearing loss and an additional disability may be enrolled at a much later age in an intervention program.

Yoshinaga-Itano (2000) demonstrated that enrollment in a comprehensive, family centered intervention program promotes child development outcomes after the identification of hearing loss. Family centered care is crucial because the parents are seen as a crucial team member and often carry out therapy plans when professionals are

not providing services. Carney and Moeller (1998) found that family centered care enhanced decision making and helped the family to promote their child's development and learning. In addition, Meadow-Orlans and Steinberg (1993) reported that family supports enhanced parent-child interaction as well as improved child developmental outcomes.

Sass-Lehrer (2003) remarks that early intervention programming involves the delivery of services to children and their families in a variety of environments in which professionals use approaches, materials, and resources that are specifically designed to promote the child's development. An effective program must have a clear philosophy that addresses both the professionals and family's role in the child's developmental goals. Each intervention program should utilize an assessment tool that examines all areas of child development including: cognition, communication and language, social-emotional, fine-motor, gross motor, adaptive skills, and for preschool aged children early literacy and pre-academic skills (Sass-Lehrer, 2003). Professionals from different disciplines, along with the families identify assessment goals that will result in a complete developmental profile of the child. A family centered approach is crucial to the assessment process. The family can provide pertinent information about the child's development, interactions, and disposition. Members of the assessment team should try to focus on the child's strengths instead of constantly discussing what the child is unable to do.

Once the assessment is completed the next step of the intervention program is identifying the outcome goals for the child and family. According to Sass-Lehrer (2003), outcomes are defined as broad statements that describe a desired change to occur for the

child or family with the support of the intervention services. These outcomes should be determined through a collaborative process between the professional team members and the family based on the results of the assessment process. Outcomes should address all development areas and be meaningful to the child and family (Sass-Lehrer, 2003). With a family centered approach the parents should be given the opportunity to share their priorities for their child first. After the family shares their goals the professionals can present their views and add additional goals to advance the child's development. Once a consensus is reached on the goals and outcomes professionals should work with the families to identify the behaviors that demonstrate that the child is making progress toward these goals and outcomes (Sass-Lehrer, 2003).

The primary focus of the early intervention services should be on communication and language acquisition. Communication goals should emphasize everyday interactions between the child and the child's caregivers (Sass-Lehrer, 2003). These parent-child interactions are crucial to enhancing the child's speech and language development. Programming should be flexible in nature allowing the families to select the therapies that best reflect their child's needs. Professionals should be respectful if a family decides to delay or lessen the occurrence of a particular therapy. At times families can feel undue burden because of constant therapy sessions and invasion of privacy during home therapy sessions.

The final part of an intervention program is the evaluation stage. Evaluations document the child's progress and the family's satisfaction with the intervention strategies and the services provided (Sass-Lehrer, 2003). These evaluations may include parent interviews, anecdotal records, parent interviews, developmental checklists, and

videotaped samples of behavior. Evaluations should take place every six months for children younger than three years of age and on a yearly basis for older children. The data obtained from these evaluations should be utilized to update the outcomes and strategies on the child's individualized education program (IEP) or Individualized Family Service Program (IFSP).

Early Intervention Learning Environments

These services can be provided in a variety of environments including the home or a community center (Sass-Lehrer, 2003). Ultimately the decision is up the family. In some cases the home environment may be the best option. The services come directly to the family and they do not need to worry about transportation issues. In addition, the child is provided a naturalistic setting to receive therapy among their family members. Other families may choose to select a community or program center in which they can interact with other families whose children have similar disabilities.

Early Intervention Program Models

There is no definitively accepted program for providing services to young children with hearing loss. This section will briefly address three different early intervention models. The Colorado Home Intervention Program (CHIP) provides family-centered programming within the home setting. A specially trained early intervention provider helps the family develop approaches and techniques that promote the child's overall development with a special emphasis on communication and language (Sass-Lehrer, 2003). The family facilitator helps to promote collaboration between services and agencies available to the family with their community. Other services may include

the arrangement of an individual with hearing loss or individual who is deaf to visit the family on a regular basis to provide information and support (Sass-Lehrer, 2003).

The SKI-HI Model developed at Utah State University is a weekly home based family service model. SKI-HI focuses on helping the family adapt to the child's hearing loss. In addition the program attempts to educate the family about the etiology of the hearing loss, cognitive and social development, and amplification devices (Sass-Lehrer, 2003). Parent advisors are provided to help families learn the skills that will help promote the child's communication, language, and cognitive development. SKI-HI includes programming curriculum, assessment materials, as well as resources for parent advisors on delivering services to families (Sass-Lehrer, 2003).

The Ready to Learn Program utilizes a Mediated Learning Experience (MLE) model which attempts to engage parents and children as active learners during the process. This program attempts to develop efficient thinking skills that promote autonomous and independent learning (Sass-Lehrer, 2003). Professionals work along side families to encourage early learning and problem solving in their children. Eventually parents assume the role of mediator and act as interpreters to give meaning to objects, events, and thoughts. This program focuses on teaching families how to sharpen their child's skills of reflection, observation, and critical thinking (Sass-Lehrer, 2003).

Pre-School Services

Children with autism and hearing loss will almost certainly receive special education services in the preschool setting. Decisions are often made based upon the communication modality the family is most comfortable with. These services may need to be adapted based upon the unique combination of hearing loss and autism. Preschool

programming should attempt to provide a language-rich environment which encourages daily story-telling and book sharing activities (Linder, 1999).

CHAPTER 7

CONCLUSION

The goal of this paper was to conduct a thorough review of the literature regarding autism and hearing loss. Throughout the process of reviewing the literature it was evident that few good studies have been conducted about autism and hearing loss. Questions still remain about the prevalence of hearing loss in children with autism (Rosenhall et al., 1999). Some studies have found greater prevalence than in the normal childhood population while other studies indicated little difference between the normal childhood population and children with autism. Within many of these studies questionable methodologies and study design were utilized. Nearly no literature exists about how to modify testing techniques for children with autism. For these reasons a true evidence based practice review was difficult to complete for the purposes of this paper. This paper attempted to utilize studies outside the area of audiology which addressed characteristics related to autism and how they could impact the diagnostic process, the fitting of hearing aids, and intervention programs. Many of the suggestions for modifying testing was based upon research which has established specific characteristics of children with autism along with the author's own personal clinical experience. This experience included working on a transdisciplinary team as a graduate clinician along with a year long externship at children's hospital. Clearly personal clinical experience is very low on the evidence based practice pyramid, but this paper argues that these findings

do have significant value for a number of reasons. First, very few studies addressed how to modify testing for children with autism. Of the studies that did address how to adapt testing techniques all were based on anecdotal/clinical experiences that utilized findings outside the realm of audiology to create recommendations on how to complete testing. Secondly, it would be very difficult to design a study which weights how important a modification was in completing the testing or gaining accurate test results.

This is not an endorsement to completely abandon evidence based practices related to children with autism and hearing loss. Evidence based practice has been crucial in the area of autism in determining appropriate intervention practices as well as lessening the legitimacy of myths such vaccinations causing autism. This paper suggests that future evidence based work in the area of autism and hearing loss would include the following: a large scale study of children with autism of varying intellectual abilities to determine the prevalence of autism and hearing loss, further research which examines whether Auditory Brainstem Responses (ABR) of children with autism and normal hearing differ from the their normal hearing counterparts who do not have autism, the evaluation and establishment of outcome measures for children who utilize amplification and have autism.

This paper examined the role of an audiologist in the diagnostic process of a child suspected of autism in both the team format as well a stand alone clinic. It was determined that the audiologist has a professional responsibility to make an appropriate referral if the child demonstrates behavior that is concerning to the audiologist or the parent reports specific behavioral concerns. Throughout the process flexibility is crucial. The audiologist should be prepared that an audiological evaluation may take more than

one session. In addition, they may need to modify testing techniques. If hearing loss is found the audiologist needs to be prepared to work with other team members, professionals, or school officials. A specific hearing aid plan should be created for the child based upon their intellectual, motor, and social functioning. In all cases the needs of the family should be at the forefront. Family centered care empowers the family to make decisions about their child's care based upon their needs and the recommendations of professionals.

Autism is a very prevalent disorder as the number of children diagnosed continues to grow in the United States. Audiologists within the pediatric field must have knowledge of disorder. Even the most conservative prevalence estimates indicate that hearing loss in children with autism is at least as common as hearing loss in healthy childhood population. Eventually audiologists who work with the adult population will begin to see patients with autism as they transition from adolescence to adulthood. Continued research and clinical exploration is crucial in helping to improve outcomes for children with hearing loss and autism.

Summary

This paper examined autism and hearing loss. A review of the literature found a wide variation in the prevalence of autism and hearing loss. The paper made specific recommendations on how to modify behavioral testing techniques for children with autism. In addition, the paper provided suggestions for interventions such as a family centered hearing aid plan to address amplification issues in children with autism and hearing loss. This paper emphasized the crucial role audiologists play in the identification of autism as part of a diagnostic team and in the separate clinical setting. Typically,

audiologists are the first professionals to see children with developmental difficulties because most parents are first made aware of communicative difficulties. The paper discussed audiologists' professional responsibility to make an appropriate referral when they observe a child demonstrating developmental difficulties.

LIST OF REFERENCES

- Briggs, D. (1991). Critical care nurses' roles--traditional or expanded/extended. *Intensive Care Nursing*, 7(4), 223-9.
- Carney, A., & Moeller, M. (1998). Treatment efficacy: hearing loss in children. *Journal of Speech, Language, and Hearing Research*, 41(1), S61-84.
- Choi, B., & Pak, A. (2006). Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives and evidence of effectiveness. *Clin Invest Med*, 29(6), 351-64.
- Cloppert, P., & Williams, S. (2005). Evaluating an enigma: What people with autism spectrum disorders and their parents would like audiologists to know. *Seminars in Hearing*, 26(4), 253-258.
- Condon, W. (1975). Multiple response to sound in dysfunctional children. *Journal of Autism and Childhood Schizophrenia*, 5(1), 37-56.
- Davis, R. ., & Stiegler, N. (2005). Toward more effective audiological assessment of children with autism spectrum disorders. *Seminars in Hearing*, 26(4), 241-252.
- Deltenre, P., Mansbach, A., Bozet, C., Christiaens, F., Barthelemy, P., Paulissen, D., & Renglet, T. (1999). Auditory neuropathy with preserved cochlear microphonics and secondary loss of otoacoustic emissions. *Audiology: Journal of Auditory Communication*, 38(4), 187-95.
- Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (1994). Arlington, VA: American Psychiatric Press.
- Diagnostic and Statistical Manual of Mental Disorders Text Revision (DSM-IV-TR) (4th ed) (2000). Washington, DC: American Psychiatric Press.
- Edwards, L. (2007). Children with cochlear implants and complex needs: a review of outcome research and psychological practice. *Journal of Deaf Studies and Deaf Education*, 12(3), 258-68.
- Egelhoff, K., Whitelaw, G. ., & Rabidoux, P. (2005). What audiologists need to know about autism spectrum disorders. *Seminars in Hearing*, 26(4), 202-209.
- Fombonne, E. (1997). *Autism and pervasive developmental disorders*. Cambridge: Cambridge University Press.
- Gillberg, C., Rosenhall, U, & Johansson E. (1983). Auditory brainstem responses in childhood psychosis. *Journal of Autism and Developmental Disorders*, 13, 181-195.

- Gomot, M., Giard, M., Adrien, J., Barthelemy, C., & Bruneau, N. (2002). Hypersensitivity to acoustic change in children with autism: electrophysiological evidence of left frontal cortex dysfunctioning. *Psychophysiology*, 39(5), 577-84.
- Gravel, J., Dunn, M., Lee, W., & Ellis, M. (2006). Peripheral audition of children on the autistic spectrum. *Ear and Hearing*, 27(3), 299-312.
- Grewe, T., Danhauer, J., Danhauer, K., & Thornton, A. (1994). Clinical use of otoacoustic emissions in children with autism. *International Journal of Pediatric Otorhinolaryngology*, 30(2), 123-32.
- Grillon, C., Courchesne, E., & Akshoomoff, N. (1989). Brainstem and middle latency auditory evoked potentials in autism and developmental language disorder. *Journal of Autism and Developmental Disorders*, 19, 255-269.
- Harris, S., & Handleman, J. (2000). Age and IQ at intake as predictors of placement for young children with autism: a four- to six-year follow-up. *Journal of Autism and Developmental Disorders*, 30(2), 137-42.
- Harris, F., & Probst, R. (1997). Otoacoustic emissions and audiometric outcomes. In: M. Robinette & T. Glatke (Eds.), *Otoacoustic emissions: clinical applications*, New York: Thieme Medical Publishers, 153-180.
- Holden-Pitt, L., & Albertorio, J. (1998). Thirty years of the annual survey of deaf and hard-of-hearing children and youth: a glance over the decades. *American Annals of the Deaf*, 143(2), 72-6.
- Holt, R., & Kirk, K. (2005). Speech and language development in cognitively delayed children with cochlear implants. *Ear and Hearing*, 26, 132-148.
- Khalifa, S., Dubal, S., Veuillet, E., Perez-Diaz, F., Jouvent, R., & Collet, L. (2002). Psychometric normalization of a hyperacusis questionnaire. *ORL : Journal for Oto - Rhino - Laryngology and Its Related Specialties*, 64(6), 436-42.
- Klin, A. (1993). Auditory brainstem responses in autism: brainstem dysfunction or peripheral hearing loss? *Journal of Autism and Developmental Disorders*, 27, 282-293.
- Lily, D., & Prudy, J. (1993). On the routine use of tubetone insert earphones. *American Journal of Audiology*, 2, 17-20.
- Linder, T. (1999). *Read, play and learn!: Storybook activities for young children*. Baltimore: Paul H. Brookes Publishing.

- Lonsbury-Martin, B., Martin, G., & Telischi, F., (1999). Otoacoustic emissions in clinical practice. In F. Musiek and W. Rintelmann (Eds) *Contemporary Perspectives in Hearing Assessment*. (pp. 167-196) Boston: Allyn and Bacon.
- Meadow-Orlans, K., & Steinberg, A. (1993). Effects of infant hearing loss and maternal support on mother-infant interactions at 18 months. *Journal of Applied Developmental Psychology*, 14, 407-426.
- Moore, J. K., & Linthicum, F., (2001). Anatomy of the human cochlea and auditory nerve. In Y. Sininger and A. Starr (Eds.) *Auditory Neuropathy: A New Perspective on Hearing Disorders*. (pp. 83-98). San Diego, CA: Singular-Thomson Learning.
- National Research Council (2001). *Educating children with autism*. Committee on Education Interventions for children with autism. Washington, D.C.: National Academy Press.
- Northern, J. & Downs, M. (2002). *Hearing in children* (5th ed). Philadelphia: Lippincott, Williams, & Wilkins.
- Novick, B., Vaughan, H., Kurtzberg, D., & Simson, R. (1980). An electrophysiologic indication of auditory processing defects in autism. *Psychiatry Research*, 3, 107-114.
- Patel, D., Pratt, H., & Patel, N. (2008). Team processes and team care for children with developmental disabilities. *Pediatric Clinics of North America*, 55(6), 1375-90.
- Pratt, H., & Rickerts V. (2004). Concepts of multidisciplinary v interdisciplinary approaches to team work. *Society for Adolescent Medicine Newsletter*, 14(3), 4-7.
- Rabidoux, P. (2005). Early identification of autism: Roles of the speech-language pathologist and audiologist on a transdisciplinary team. *Seminars in Hearing*, 26(4), 210-216.
- Rosenhall, U., Nordin, V., Sandstrom, M., Ahlsen, G., & Gillberg, C. (1999). Autism and hearing loss. *Journal of Autism and Developmental Disorders*, 29, 349-357.
- Rosenhall, U., Nordin, V., Brantberg, K., & Gillberg, C. (2003). Autism and auditory brainstem responses. *Ear and Hearing*, 24 (3), 206-214.
- Sass-Lehrer, M. (2003). Programs in services for deaf and hard of hearing children and their families. *The young deaf or hard of hearing child*. Eds. B. Bodner-Johnson & M. Sass-Lehrer. Baltimore: Paul H. Brookes Publishing, 153-180.

- Singer, J. (1999). Why can't you be normal for once in your life?: From a problem with no name to the emergence of a new category of difference. *Disability discourse*. Eds. M. Corker & S. French. Philadelphia: University Press, 59-67.
- Skoff, B., Fein, D., McNally, B., Lucci, D., Humes-Barrtlo, M., and Waterhouse, L. (1986). Brainstem auditory evoked potential in autism. *Psychophysiology*, 23, 462.
- Soskolne, C. (2000). Transdisciplinary approaches for public health. *Epidemiology*, 11, S122.
- Student, M., & Sohmer, H. (1978). Evidence from auditory nerve and brainstem evoked responses for an organic brain lesion in children with autistic traits. *Journal of Autism and Childhood Schizophrenia*, 8(1), 13-20.
- Taylor, M., Rosenblatt, B., & Linschoten, L. (1982). Auditory brainstem abnormalities in autistic children. *Canadian Journal of Neurological Sciences*, 9, 429-433.
- Tharpe, A., Fino-Szumski, M., & Bess, F. (2001). Survey of hearing aid fitting practices for children with multiple impairments. *American Journal of Audiology*, 10(1), 32-40.
- Tokar-Prejna, S., & Meinzen-Derr, J. (2006). Relationship between transducer type and low-frequency hearing loss for patients with ventilation tubes. *International Journal of Pediatric Otorhinolaryngology*, 70(6), 1063-7.
- Wetherby, A., Koegel, R., & Mendel, M. (1981). Central auditory nervous system dysfunction in echolalic autistic individuals. *Journal of Speech & Hearing Research*, 24(3), 420-9.
- Wilson, N., & Gleason, M. (2001). Team role and leadership. Retrieved December 1, 2008, *Houston Geriatric Interdisciplinary Team Training Curriculum* from <http://gitt.org/nursing.htm>.
- Yoshinaga-Itano, C. (2000). Successful outcomes for deaf and hard-of-hearing children. *Seminars in Hearing*, 21(4), 309-326.
- Yoshinaga-Itano, C., & Apuzzo, M. (1998). Identification of hearing loss after age 18 months is not early enough. *American Annals of the Deaf*, 143(5), 380-7.